How Original Huff Model works

|http://desktop.arcgis.com/en/arcmap/10.3/tools/business-analyst-toolbox/how-original-huff-model-works.htm

The Huff Model is an established theory in spatial analysis. It is based on the principle that the probability of a given consumer visiting and purchasing at a given site is a function of the distance to that site, its attractiveness, and the distance and attractiveness of competing sites.
This specific model, in the area of spatial interaction research, was refined and made operational by Dr. David Huff of the University of Texas nearly 40 years ago. The advent of powerful desktop computers has made it possible to apply the model.
The basic Huff formulation of the Gravity Model takes the following form:

$$P_{ij} = \frac{W_i / D_{ij}^{\alpha}}{\sum_{i=1}^{n} \left(W_i / D_{ij}^{\alpha} \right)}$$

Where:
Pij = the probability of consumer j shopping at store i.
Wi = a measure of the attractiveness of each store or site i.
Dij = the distance from consumer j to store or site i.
a = an exponent applied to distance so the probability of distant sites is dampened. It usually ranges between 1.5 and 2.
In practice, census polygons (for example, block groups) are substituted for individual consumers. The calculated probability for each polygon is multiplied by a data element in the polygon database (for example, households and dollars spent on groceries). This measure can be summarized to give an estimate of the total. Some measure of size, such as gross leasable area (GLA), is often used as a surrogate for attractiveness.
A site has many attributes that make it attractive to consumers. Attractiveness can be computed as a function of many attributes. For a retail store, these would be its retail floor space, number of parking spaces, and product pricing. Attractiveness of a car dealership could be a function of its display area, frontage, and advertisement. The attractiveness of an office building could be a function of the number of offices currently located within it. Attractiveness is expressed as one number that combines all

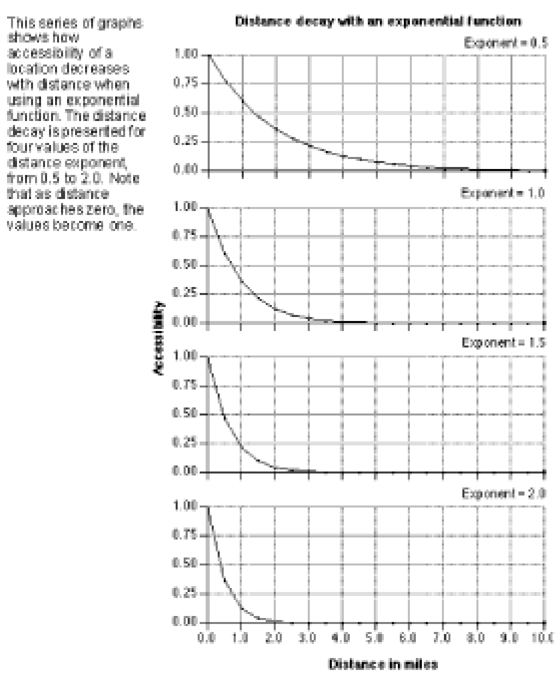
the factors that make a center attractive. This one number is usually referred to as an index. This index could also be derived by counting how many people come to that destination or by conducting a consumer survey.

You can control the distance the Huff Model will extend. Enter a value that will encompass all your competitors. You can use the Measure tool to estimate the distance. The distance units can be either miles or kilometers.

Listed below are some commonly used terms and their meanings in the context of gravity models.

Distance-decay function

The perception of how far a destination is may not be a linear function of distance. People are more likely to shop at a place close to home than one far away. Distance is viewed as a nonlinear deterrent to movement. This phenomenon can be modeled by using a distance-decay function. The use of a power distance-decay function is borrowed from Newton's law of gravitation, from which the term gravity model is derived. A distance-decay parameter, symbolized by the Greek letter beta, can be used to exaggerate the distance to destinations. Some activities, such as grocery shopping, have a large exponent, indicating that people will travel only a short distance for such things. Other activities, such as furniture shopping, have a small exponent, because people are willing to travel farther to shop for furniture.



The exponential function is typically used for computing interactions over a small distance, such as within a city.

Original Huff Model

|http://desktop.arcgis.com/en/arcmap/10.3/tools/business-analyst-toolbox/original-huff-model.htm

Summary

Creates a probability surface to predict the sales potential of an area based on distance and an attractiveness factor.

Usage

Legacy:

The Original Huff Model was referred to as the Gravity Model in previous versions of Business Analyst.

- The results of the Huff Model can be used to
    - Estimate, define, and analyze market potential.
    - Assess economic impact of a new site location.
    - Forecast sales and potential of existing stores and outlets.
    - Assess the impact of competitive and environmental changes on outlet performance.
- The output of the Huff Model will generate probabilities and estimated sales for each subgeographic area.

  The output probabilities can be used to define primary market (trade) areas for a new store location. For example, a trade area can be created using the Dissolve By Attribute Range tool to create a primary market area that includes all the subgeography areas that have a probability higher than 40 percent of patronizing the new store location.
- If you want to use more than one attractiveness value, you should use the Advanced Huff Model tool.
- The **Sales Potential Layer** is usually polygon features representing subareas where potential customers live. Point features can also be used; for example, block centroids that have associated demographic data.
- The **Competitive Store Layer** should include all competitive locations in a given study area. This layer should also include any of your existing store locations in the study area, since they will act as competitors to a new store location. In most cases, this layer will be a Business Analyst store layer. Competitive store locations can be extracted from the **Add Business Listings** function in Business Analyst.
- A higher **Distance Coefficient** indicates that distance will have a greater impact on consumer behavior. For example, consumers are more willing to travel farther for

high-order goods, such as automobiles and furniture, than they are for low-order goods, such as groceries.

- The spatial reference of the output feature class will be the same as the sales potential layer.

Parameter	Explanation	Data Type
SalesPotentialLayer	The features used to calculate the sales potential of the Huff Model.	Feature Layer
PotentialSalesFldName	The field containing the values used to calculate the sales potential of the Huff Model.	Field
StoreLayer	The layer that contains the competitive points (usually stores) used to determine how sales are influenced and distributed across the analysis area.	Feature Layer
AttractivenessField	The attribute field that determines how attractive each competitor is. In many cases, the size of the store is used as a surrogate for attractiveness.	Field
WayToDefineStoreLocation	Determines how the potential layer will be selected. • BY_COORDINATES —Enters latitude and longitude coordinates as the center point for the potential layer. • FROM_LAYER —Selects a point layer from an existing layer as the potential site.	String
RadiusOfCovering	Sets the radius of the Huff Model. The model output will extend from the potential site location to this distance.	Double
MeasureUnits (Optional)	The units used with the distance values. By default, the units defined in the Business Analyst preferences will be selected. • Minutes • Decimal Degrees • Feet	String

Parameter	Explanation	Data Type
	• Kilometers • Meters • Miles • Nautical Miles • Yards	
DistanceCoefficient	The value that determines how much of a factor travel distance is to the consumer.	Double
Attractiveness	The value that measures how attractive the potential store is to consumers.	Double
OutputFeatureClass	The output feature class that will contain the Huff Model results.	Feature Class
Longitude (Optional)	The x-coordinate (longitude) for the potential site.	Double
Latitude (Optional)	The y-coordinate (latitude) for the potential site.	Double
PotentialStoreLayer (Optional)	The existing point feature class used to define the potential store location.	Feature Layer
PotentialStoreOID (Optional)	The unique identifier for the potential store location.	Long